

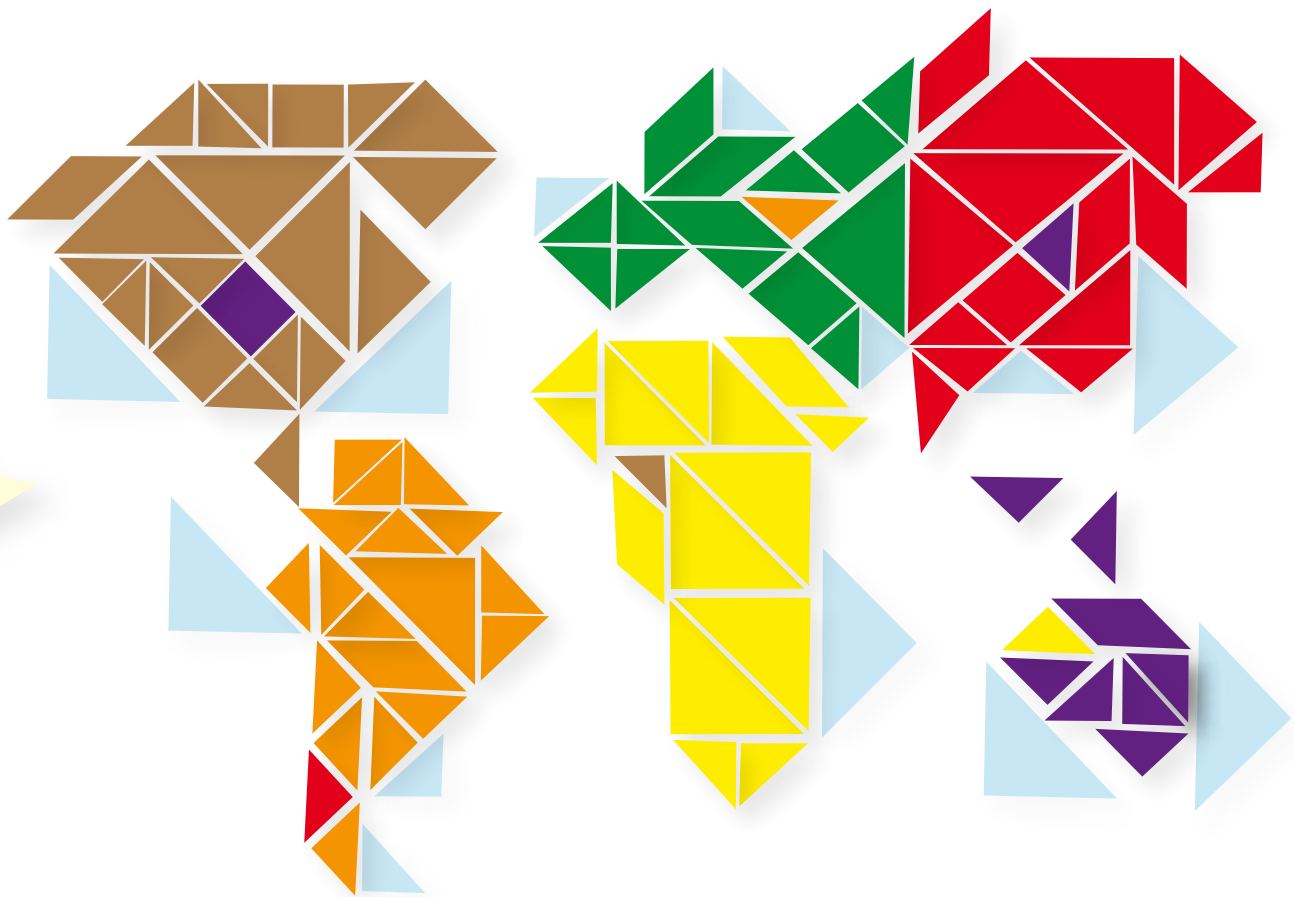
CUCS
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2013



**IMAGINING CULTURES OF COOPERATION:
UNIVERSITIES NETWORKING TO FACE THE NEW DEVELOPMENT CHALLENGES**

Proceedings of the III Congress of the University Network for Development Cooperation (CUCS)

Turin, 19-21 September 2013



**POLITECNICO
DI TORINO**



**UNIVERSITÀ
DEGLI STUDI
DI TORINO**

Egidio Dansero, Francesca De Filippi, Emanuele Fantini, Irene Marocco (eds.)

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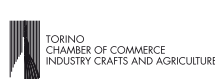
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The Italian Universities Network for Development Cooperation (CUCS) has been founded in 2007 and nowadays includes 28 Italian Universities. The III CUCS Congress (CUCSTorino2013) was held in Turin on the 19th, 20th, and 21st of September, 2013. CUCSTorino2013 was co-organised by Politecnico di Torino and University of Turin in the frame of the growing partnership between these two Universities with other relevant development cooperation actors (the UN system, the Italian Ministry of Foreign Affairs, local authorities, foundations and NGOs and their respective partners in the so called “Global South”).

The Congress, titled “Imagining cultures of cooperation: universities networking to face the new development challenges”, focused on changes occurring at different levels on current development and cooperation trends (theories, policies, practices, and the definition of the Global Development Agenda post 2015), on the role of universities as development cooperation actors and their contribution in terms of research, education & training, solutions implementation in the field, technology transfer and co-creation.



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Imagining cultures of cooperation: universities networking to face the new development challenges

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**STRATEGIES OF LAND EXPLOITATION AND MANAGEMENT IN THE AREA OF AKSUM
(NORTHERN ETHIOPIA)
BETWEEN THE 1ST MILLENNIUM BC AND THE 1ST MILLENNIUM AD**

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ABSTRACT

Northern Ethiopian highlands, as well as most of the country and the whole Horn of Africa, have always been perceived as low-productivity regions with very fragile ecosystems, where local communities, often relying on a traditional ox-plough agriculture, are continuously exposed to the threat of drought, famine and starvation because of environmental and social factors.

This paper intends to contribute to the reconstruction of the long-term dynamics of human-environmental interactions in these regions by analyzing how agricultural land was managed, exploited and manipulated and how ancient farming communities faced environmental degradation phenomena like soil impoverishment and erosion.

The study will focus on the area of Aksum, an important historical centre located in the region of Tigray, northern Ethiopia, which emerged between the 1st millennium BC and the 1st millennium AD as the capital city of a vast kingdom. Agriculture in Aksumite history is commonly regarded as a system in which problems of soil-exhaustion are linked to land clearance and population increase, and the intensification of agricultural resources' exploitation has long been considered the trigger for both Aksum's rise and decline. Nevertheless, archaeological and paleoagricultural investigations recently conducted in the area significantly clash with this model, suggesting that even during the periods of greatest extent of Aksumite kingdom the erosion rate was relatively low, proving the effectiveness of Aksumite farmers strategies in managing and maintaining soil. The debate, far to be resolved, represents an useful spur to the course of research as understanding ancient farming systems may facilitate the design of future strategies for sustainable land-use.

INTRODUCTION

The northern regions of Ethiopian highlands have, for many years, been perceived as low-productivity areas characterised by extremely fragile ecosystems where climatic fluctuations and/or conflicts among ethnic groups or polities periodically result in severe phenomena of environmental, social, and economic deterioration. Episodic events or long-enduring processes continuously act at local and regional scales, threatening local communities with chronic drought, famine, and starvation. Land-use and land-management strategies, and their environmental, economical and social bearings, are therefore issues of great significance for present Ethiopia as 85% of the country's economy is based on agriculture practiced with traditional techniques and equipment. In particular, soil erosion processes are considered a major factor heavily affecting rural ecosystems.

This paper will describe the results of over ten years of combined archaeological and paleoenvironmental studies

conducted in the area of Aksum (Tigray, northern Ethiopia) by the University of Naples “L’Orientale”¹ in collaboration with geologists, geoarchaeologists and soil scientists from Boston University (USA), University of Cambridge (UK), University of Florence and University of Ferrara (Italy), and aimed at investigating ancient strategies of manipulation and exploitation of the territory and at reconstructing long-term dynamics of human-environment interaction in this area, also in the light of present phenomena of environmental degradation and soil erosion processes.

The basic theoretical assumption is that archaeology can give a significant contribution to larger debates on present environmental degradation and on the role played by human communities in ecological dynamics providing evidence about long-term ecological processes and on their temporal nature. Archaeology, actually, has progressively developed very sophisticated procedures to recover, analyse and explain, by means of cultural materials, the traces left by human actions on a specific territory and to organize such evidence in spatial-temporal sequences with century scale resolution for the Late Holocene.

The research adopted a multidisciplinary approach that integrated innovative methodologies with well established procedures. Archaeological, geoarchaeological, geological and ethno-historical investigations generated site-specific datasets necessary to model the ancient landscape of the area, and provided new perspectives for analyzing the causes and rates of ancient erosion dynamics, and the evaluation of the relevance and effectiveness of ancient strategies adopted by rural communities to face this problem. Archaeological investigations included the systematic, complete-coverage survey of the area of Aksum [1] in order to document the distribution of archaeological evidence within the region and to reconstruct the ancient settlement pattern. Geoarchaeological, geological and pedological investigations represented a basic component of the project as they provided paleoenvironmental evidence for a more detailed correlation between natural and cultural phenomena. Archaeological, geological, and geoarchaeological evidence were spatially positioned using GPS and related information have been uploaded, through geo-referencing, in a Geographical Information System and analysed through the implementation of thematic maps, statistical and spatial analysis, Remote Sensing and 3D modelling. Ethno-historical researches and enquiries were conducted to get information from written historical sources and local oral traditions about local and regional environmental changes, land-use and land-management strategies, and demographic pressure. In particular, ancient Ethiopian texts, reports by European travellers who visited the country since the 15th century and recent data published by International Agencies were scrutinised. Finally, information about modern infrastructures have been recorded as a first step towards possible future strategies of protection and promotion of traditional knowledge as an important aspect of the cultural heritage.

SOIL EROSION AND ANCIENT HUMAN COMMUNITIES: NEW EVIDENCE FROM ARCHAEOLOGICAL AND PALEOENVIRONMENTAL STUDIES

The city of Aksum is located in Tigray, the northernmost region of Ethiopian highlands (Fig. 1), at an average altitude of about 2,200 m asl, in an alluvial plain situated at the hub of a radiating network of river valleys linking the area with the surrounding regions. The plain is dominated in the centre by two prominent hills, Bieta Giyorgis and May Qoho while a ring of surrounding hills forms the natural boundary of the territory (Fig. 2). The geological and lithological variety of the area results in a mosaic of soils with a different degree of productivity [2].

The area is characterized by a tropical climate with an average annual temperature between 15° C and 20° C, and by highly seasonal rainfall, mainly concentrated between June and September. In moist periods, a second rainfall may

¹ The Italian Archaeological Expedition at Aksum of the University of Naples “L’Orientale” conducts archaeological researches in the area of Aksum since the early nineteen-nineties. From 1993 to 2003 has conducted archaeological investigations on the hilltop and northern slopes of Bieta Giyorgis hill in collaboration with the Boston University (co-directors Rodolfo Fattovich and Kathryn A. Bard). Between 2004 and 2009 has investigated the plain to the north of Aksum and the eastern, western and southern slopes of Bieta Giyorgis (director Rodolfo Fattovich). Since 2010 conducts researches at the pre-Aksumite site of Seglamen, ca. 12 km to the SW of Aksum (director Rodolfo Fattovich).

occur between March and May. Paleoenvironmental studies suggest that, during the Holocene, this region experienced an alternation of wet and dry periods with an evolution towards more arid climatic conditions from 1000 AD [3, 4, 5, 6, 7].

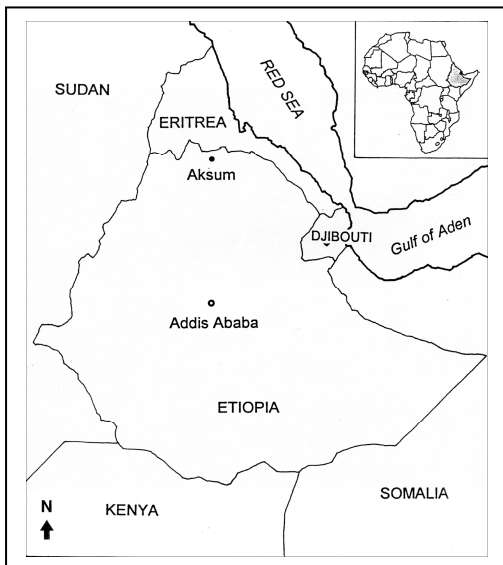


Fig. 1 – Location of the study-area

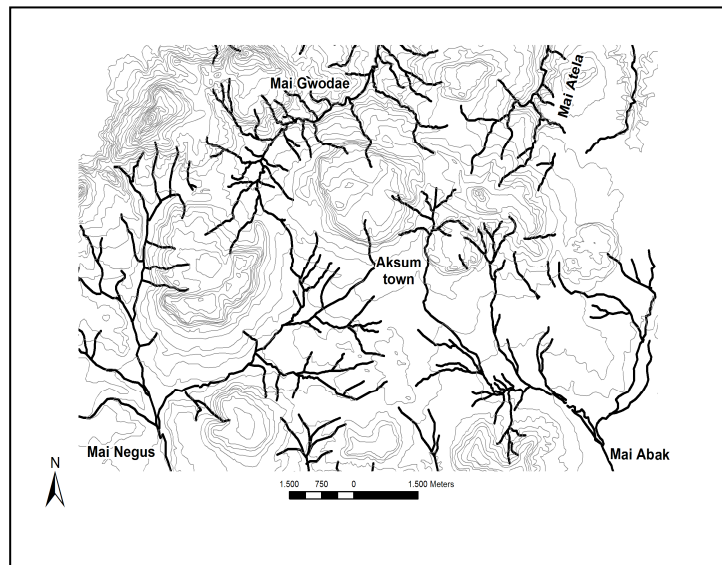


Fig. 2 – The plain of Aksum with major river valleys

The vegetation pattern is characterized by perennial herbaceous plants, thickets of bushes and scattered, medium-height trees, including acacia and African olive. Eucalyptus have been planted since the beginning of the 20th century. The domestic fauna includes dromedaries, asses, cattle, sheep, goats and poultry, while wild species are mainly represented by hyenas, baboons and a wide variety of endemic and other birds.

From about the 1st century BC, the area of Aksum progressively emerged as the capital city of a powerful and vast kingdom (the so-called “Kingdom of Aksum”) directly involved in a long-distance exchange circuit which included the northern Horn of Africa, the Nile Valley, the Mediterranean, Southern Arabia, and the western coastal regions of India [8, 9]. Nowadays, Aksum is one of the most important religious centre of the Ethiopian Orthodox Church, and a very important symbol of Ethiopian cultural identity. Moreover, it is presently one of the major archaeological areas in the country, and is included in the UNESCO World Heritage Sites List.

Due to its geographical position, the area of Aksum is exposed to severe phenomena of environmental degradation, the whole ecosystem being extremely sensitive to climatic changes. One of the most common forms of landscape degradation occurred in this region is soil erosion. The current model for ecological history of the area of Aksum, and of the whole Tigrean plateau, argues for a progressive increase in land clearance and human impact on the natural environment due to the intensification of agriculture since the 3rd-2nd millennia BC, which ultimately resulted in severe soil impoverishment and erosion processes [3, 4, 10, 7].

On the contrary, recent archaeological, pedological, geomorphological, and paleoagricultural investigations in the area highlighted new and encouraging results concerning the effectiveness of ancient terracing systems and land-management for the conservation/exploitation of the hill slopes and provided significant information on the possible causes of soil depletion and erosion [11, 12, 13].

Research, carried out at a local scale, involved the northern slopes of Bieta Gyorgis hill, an area largely devoted to farm-lands where the present landscape is characterized by scattered isolated rural dwellings or hamlets alternated with cultivated fields. A smaller portion of the total area is given over to grazing while most of the up-slopes is characterised by forests of eucalyptus planted to minimize soil erosion.

Here, as in many other parts of the Tigrean plateau, farming has been practiced along the slopes of the hills since at

least since the mid-1st millennium BC, by means of a terracing technique which helps to reduce the gradient and improve the drainage of the soil [14, 7]. The traditional plough still used in the region is the maresha, an “ard plough” drawn by a pair of oxen that seems to have been introduced in Ethiopia since at least the 1st millennium BC [15]. The impact of the plough against the stones is frequent, and the stones are consequently scratched (Fig. 3): 1) on the top if rocks are at a lower depth than the tilling depth (8-16 cm), or 2) on the sides if rocks are protruding [11, 12]. The occurrence of plough- marks, thus, is a safe evidence for past cultivation on lands presently cultivated or abandoned.

In the case of Aksum, the finding of large outcropping rocks with ancient plough-marks in the now abandoned area between Enda Giyorgis and Ma Qono, on the northeastern slopes of Bieta Giyorgis hill, allowed to reconstruct ancient cultivation procedures and agricultural terracing systems. The systematic mapping and study of the diverse thickness and orientation of the marks suggest that ancient ploughing procedure was, similarly to present, characterised by concentric movements of the plough along the perimeter of the terraces, from the outer edge towards the centre [11, 12]. Moreover, as the plough-marks may be found at different levels on the outcropping rocks, these provide a reliable indication of the soil erosion rate during the various chronological phases. The chromatic differences in the superficial alterations of the rock (becoming progressively darker as exposure to external pressure and atmospheric agents increases) show that the highest marks are the most ancient while those found lower down are progressively more recent (Fig. 4). The correlation between different levels of alteration recorded on the rocks and the phases of utilization of the terraces testified by the associated archaeological material, allowed to estimate the rate of soil erosion occurred in the area from the Aksumite period up to the present. The study suggests that the level of erosion occurred in the area during the 1st half of the 1st millennium BC (which is a period of increasing demographic pressure in the area [16, 17, 18]) is between 1.9 and 4.8 t ha⁻¹ y⁻¹ [11, 12].



Fig. 3 – Plough impacting outcropping rocks



Fig. 4 – Ancient plough-marks on a boulder³

This value, which is much lower than the threshold erosion rate commonly accepted by international soil conservation agencies, shows that ancient strategies of land management and exploitation were effective and that the whole ecosystem was extremely stable. On the contrary, the land reform started up in the early nineteen-seventies during the socialist regime of Menghistu Haile Maryam, which led to the abandonment of the area under examination, caused a significant increase in the rate of soil erosion which sharply accelerated environmental degradation processes. Thus, at least in this area, high demographic pressure and soil exploitation should not be considered the principal cause of soil depletion and erosion. On the contrary, anthropic presence and land-exploitation appears to play a crucial role as

² Tons per hectare per year.

³ Figures 3 and 4 are courtesy of Rossano Ciampalini.

agricultural infrastructures contributes to preserve the landscape and to maintain an environmental stability. Rather, soil erosion and impoverishment seem to be the result of a progressive lack of maintenance of the infrastructures connected with the abandonment of the area. The relationship between soil erosion and human activity in the Aksum area should therefore be considered in a new perspective, probably nearer to the paradigm “More people less erosion” introduced by Tiffen at the end of the last century [19]. This interpretation seems to be confirmed by modern data according to which the areas worst hit by soil erosion in the Ethiopian highlands are those which are not currently exploited (3.8% of the total) with an erosive intensity of 70 t ha⁻¹ y⁻¹ [20]. Geoarchaeological analysis conducted on exposed paleosoils in the same area confirm that between the 1st millennium BC and the 1st millennium AD the territory was characterised by stable environmental conditions with localised, low-energy erosional episodes [13, 18].

The hypothesis emerged by paleoenvironmental data and ancient plough-marks is supported by archaeological evidence as suggested by the reconstruction and analysis of the ancient settlement pattern of the study-area, and, in particular, of the diachronic changes occurred in the spatial correlation among ancient rural settlements; a method commonly used for measuring anthropic reaction to environmental changes [21]. If, as is commonly claimed, excessive anthropic pressure degraded the local environment by accelerating soil erosion processes, the people who occupied and exploited the northern slopes of Bieta Giyorgis hill would eventually be compelled to abandon this portion of the territory and to relocate their activities to more productive areas. This process of periodic relocation should be detectable in the archaeological record in the form of spatial segregation among sites from adjacent chronological periods and by the reduction in the number of settlements in the area under examination in favour of an increase of the latter in other parts of the territory. On the contrary, in the absence of erosion or environmental degradation phenomena, an economically productive area will be exploited constantly over time and the distribution of the settlements will show a high degree of spatial aggregation. Quantitative analysis and statistical measures of spatial correlation have been employed on sites from adjacent temporal periods to evaluate the degree to which settlements were relocated from one period to the next; nearest-neighbour (NN) analysis is the one presented here. The NN coefficient is a tool frequently used in the sphere of archaeology and human geography consisting of a ratio of the actual average distance between the nearest neighbours among a set of points, and the expected average distance if the same number of points were randomly distributed within the same area [22]. Values around 1.0 indicate a random distribution while values greater than 1.0 are indicative of spatial segregation; values smaller than 1.0 indicate a concentrated distribution of points with a high rate of spatial aggregation. In this case, the coefficient of spatial correlation was also combined with the diachronic changes in the number of settlements recorded in the area under examination and in the whole Aksum territory.

Diagram 1 clearly shows how, during the whole Aksumite period (ca. 50 BC-AD 700), the area under examination was generally characterized by a spatially aggregated distribution of the settlements with a NN coefficient reaching its lowest value (and thus the pick of spatial aggregation) during the Middle Aksumite period (ca. 350-550 AD, “Aksumita Medio” in the diagram). Thence, the settlement pattern of the area seems to confirm the hypothesis obtained from geoarchaeological analyses and from the erosion model elaborated on the basis of paleoagricultural evidence, according to which, during the Aksumite period, characterized by intense demographic pressure and by constant agricultural exploitation of the north-eastern slopes of the Bieta Giyorgis hill, the traditional management system of the territory proved to be sufficient to minimise the rate of soil erosion along the slopes, allowing a constant exploitation of the study-area.

A slight decrease in settlements’ spatial aggregation occurred between the end of the Middle Aksumite period and the Post-Aksumite period (ca. 550-1100 AD, “Post-Aksumita” in the diagram). This phenomenon should be most likely related to the general demographic decrease which affected the area of Aksum during this period [17, 18, 23] and resulted in the progressive decline of Aksum’s political and economic importance. Whatever the cause of this demographic decline was, the progressive abandonment of the area might have accelerated soil erosion phenomena due to both environmental factors and the lack of MAINTENANCE of infrastructures as geoarchaeological evidence

suggests that, between the 7th and 8th century AD, the whole Aksum territory was subjected to severe environmental degradation [3] and that, towards the end of the 1st millennium AD, the whole Tigrean plateau was affected by a period of environmental instability probably due to a phase of greater aridity [6]. The abandonment of an area may be the result of the interac

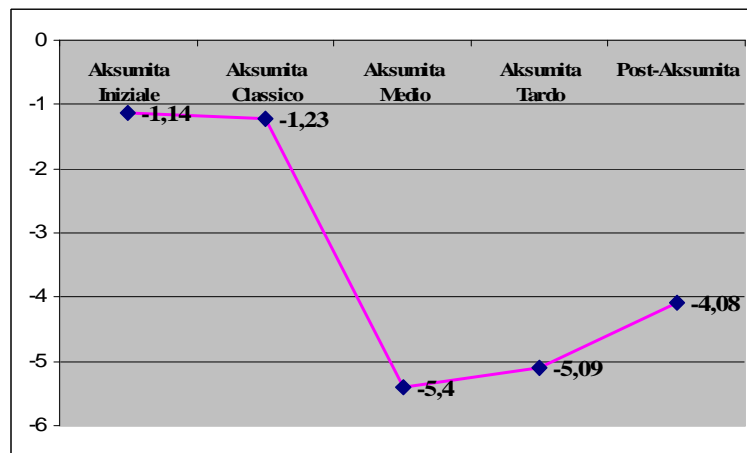


Diagram 1 – NN coefficient in the area of Aksum

Although military actions today strongly contribute to accelerate environmental degradation processes of the region by forcing communities to abandon the areas they live in and to find different strategies for exploiting the environment, famines caused by drought, invasions of locusts or epidemics, are to be considered as well. Different types of sources show that these problems are not limited to the recent history of the region. Archaeological evidence suggests that eastern Africa appears to having been affected by plague at least since the 6th century AD [17, 23], when, according to Procopius, the so-called “Justinian Plague” spread from northeastern Africa to the whole of the Mediterranean [24]. Historical sources highlight that the history of famine on the Tigrean plateau, recorded in literature and in the local and foreign chronicles, goes back at least to the 8th-9th century AD, and that the phenomenon has periodically recurred ever since then [25]. The consequences that periods of epidemics and famine have on farming and on the organisation of the rural communities are well-known today from ethnographical observations. As well as the loss of human lives and livestock, famine and epidemics reduce the energy of the farming communities and leads to the destruction of natural resources through a system of progressive actions and reactions which culminate in the weakening of the social structures and the abandonment of the populated area. This process, which has been extensively studied by anthropologists and historians, is characterized by four sequential phases consisting of: a) reduction of consumption; b) temporary migration, generally limited to the head of the family; c) divestment of the environment and the available resources; and d) migration of the entire household [26]. In the most severe cases, the central government uses the mass relocation of entire communities from the areas strongly affected by the disease to less densely populated regions as a long-term solution to the problem of soil depletion and food starvation.

To conclude, the case-study here presented demonstrates that combining archaeological evidence, environmental and historical data, and ethnographical observation allows to provide a long-term reconstruction of human-environmental interplay, to identify ancient strategies of land exploitation and to investigate how ancient communities faced environmental degradation through time. This might be extremely useful to define the trajectories through which present situation emerged from the past, to increase our knowledge on the possible causes of environmental problems still affecting human communities and, perhaps, to contribute to the design of future strategies for sustainable land-use especially in those areas, like the northern Ethiopian highlands, where many activities of daily life are still practiced by using traditional knowledge and equipment.

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